Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/639
NETHERLANDS
February 1964
Original: ENGLISH

Confidential until official release during Conference

Abstract

Separation by countercurrent-exchange-electrolysis applied on lithiumisotopes

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Several applications of pure lithium isotopes are possible in the field of reactortechnology, e.g.

1) the use of lithium-7 as coolant in a nuclear reactor;
2) the application of ^{7}LiH or ^{7}LiD as moderator in a high temperature reactor;
3) the use of ^{7}LiF as solvent for nuclear fuels.

The separation of the lithium isotopes on a technical scale still constitutes a problem. According to recent publications separation by countercurrent-exchange-electrolysis is one of the rare methods, that might lead to acceptable results.

Thus far literature on this subject is rather poor. Besides a French patent, which appeared in 1959, we only found a paper of Lewis and Macdonald dated back as far as 1936. Letting descend fine droplets of amalgam through an ascending solution of lithiumchloride Lewis and Macdonald obtained a noticeable separation in a column with a length of 18m and only 4mm wide. From this paper it appears that the maintenance of the necessary zigzag movement of the amalgam droplets is a severe problem prohibiting technical application.

Recent work, done in our Institute on packed columns, lead to more promising results. When a column containing sand with a particle size of 0.35-0.5 mm is properly treated, it permits a countercurrent transport of lithiumamalgam and a solution of lithiumchloride in dimethylformamide.

The reflux at the bottom of the column, where the lithium is transported from the amalgam to the electrolyt solution (anodic reflux), has been realised by a new continuous method based on exchange-electrolysis. The cathodic reflux

is obtained by evaporating the solvent dimethylformamide, transferring the lithiumchloride into water and electrolysing the lithiumchloride solution in water.

Experiments carried out during 20 to 40 hours in an exchange column with a length of 1 to 2 m, resulted in an increase of lithium-6 content from 7.5 till 12.0 % at the bottom of the column and a decrease of lithium-6 content from 7.5 till 5.8 % at the top of the column as appeared from mass-spectrographic analysis (these data correspond with separation factors of 1.68 and 0.76, whereas the elementary separation-factor amounts to 1.05).

The application of the method to be presented is not restricted to the separation of the lithium isotopes. It also offers possibilities for the separation of the calcium isotopes and for the reprocessing of a liquid metal reactor fuel like a solution of uranium in molten bismuth.